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RCP2 Project Overview Document

Project Name:	**Bus Section Fault Reliability**
Expenditure Class:	**Base Capex**
Expenditure Category:	**Grid – Enhancement & Development**
As at date:	**June 2014**

Expenditure Forecast *Real 2012/13 NZ$ (m)*	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	**Total**
CAPEX			3.2	5.4	2.3	**10.9**

Need Identification

Describe the reason for proposing a project (i.e. **need or trigger**)	The Electricity Industry Participation Code (Code) requires that the core grid remains in a satisfactory state for a defined set of contingency events. The grid must remain stable, and continue to satisfy demand at grid exit points without unacceptably overloading transmission equipment and keeping voltages within acceptable bounds during and following a credible contingent event. This project improves reliability on three 220 kV and 110 kV buses on the core grid which currently do not meet the Grid Reliability Standards (GRS). If we identify, in a grid reliability report, that the power system does not, or is not reasonably expected to meet the GRS within the five year period following the report, we are required to consider reasonably practicable options to ensure we meet the GRS. We identified that the following core grid buses do not meet the GRS: • Haywards – a 110 kV bus section outage will overload a Haywards interconnecting transformer at times of high load: there are three interconnecting transformers at Haywards and two 110 kV bus sections. In the worst case, the outage of a 110 kV bus section will result in only one interconnecting transformer remaining in service, leaving the entire Wellington 110 kV load supplied through the remaining transformer and the Wilton interconnecting transformer. We propose installing a bus section breaker to create another bus section, so that the three Haywards 220/110 kV transformers can be connected to three bus sections; • Bunnythorpe – a 220 kV bus section outage will overload the 110 kV Bunnythorpe–Woodville circuits at times of high load and cause low voltages in the region: the loss of a 220 kV bus section at Bunnythorpe substation will result in voltages outside the acceptable range on the 110 kV network. Voltages can be kept in the acceptable range through pre-contingency load management, but this problem will ultimately be resolved through a combination of replacing the interconnecting transformers and reconfiguring the Bunnythorpe 220 kV bus with the

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	Haywards 1 and 2 circuits connected to the same bus section; and • Mt Roskill[1] – a 110 kV bus fault would result in an interruption to demand supplied by the Mt Roskill substation: the outage of the Mt Roskill 110 kV bus will cause a complete loss of supply to the 110 kV load and the 22 kV load (average load 85 MW). We have discussed this investment with Vector who has confirmed support[2] for the work. We identified three further core grid buses that do not meet the GRS. 220 kV bus faults at Whirinaki, Edgecumbe and New Plymouth would all result in interruptions to demand supplied by the associated substations. Having considered options for meeting the GRS in respect of these assets we have determined that investments are not necessary at this time[3].
What is the **timing** of the need and the **confidence level** that issue(s) will eventuate	Investigations will be undertaken to identify the most cost effective means of meeting GRS requirements. Short of new information coming to hand which alters either the need or the preferred solution, these projects will be completed during the RCP2 period. There is a high level of confidence these projects will proceed to ensure Code compliance.
Generic assumptions underpinning the need – including any modelling used	DigSilent version 14.1.3 was used to undertake the analysis.

[1] The 2013 APR, page 126 noted that any further investment on the Mt Roskill bus would be customer-driven. This is incorrect as the circuits connecting onto the Mt Roskill 110kV bus are part of the core grid. To meet the GRS there should be no loss of load for a single contingent event (for example outage of bus section or circuit) on the core grid.
[2] Email from John Welch (Vector) to Graeme Ancell (Transpower), "RE: Future 110 kV bus section CB at Roskill", sent 18/3/2014.
[3] Electricity Industry Participation Code, clause 12.114(1)(d).

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Long list of options and high level assessment

Option Type	Option	Fit	Feasible	Practical	GEIP	Security	Cost	Short list
Transmission options	a) Special Protection Scheme (SPS) to enable maintenance or unusual operating conditions	✓	✓	✓	✓	✓	✓	✓
	b) Shunt compensation by installing capacitors for voltage support	✗						✗
	c) Install additional bus section circuit breaker and bus zone protection	✓	✓	✓	✓	✓	✓	✓
	d) Substation reconfiguration	✓	✓	✓	✓	✓	✓	✓
	e) Grid reconfiguration	✗						✗
	f) System Operator intervention/operational measures	✓	✓	✓	✓	✓	✓	✓

- Fit for purpose – will meet the transmission need.
- Technical feasibility – complexity of solution; reliability, availability and maintainability of the solution; future flexibility – Grid Development Strategy.
- Practicality of implementation – Solution implementable by required date (probability of proceeding); property and environmental risks; implementation risks.
- Good electricity industry practice (GEIP) – consistent with good international practice; ensure safety and environmental protection; accounts for relative size, duty, age and technological status.
- System security (additional benefit resulting from an economic investment) – improved system security; system operator benefits (controllability); Dynamic benefits (modulation features and improved system stability).
- Indicative cost – whether an option will clearly be more expensive than another option with similar or greater benefits.

Short list of options

Option 1 – Do Nothing	'Do-nothing' – no network enhancement. The GRS is not met.
Option 2	To provide N-1 bus section security at: • Haywards: by installing a 110 kV bus section breaker to create another bus section and upgrading bus protection • Bunnythorpe: by re-arranging the 220 kV circuit connections at Bunnythorpe, with Haywards 1 and 2 circuits connected to the same bus section; and • Mt Roskill: by installing a bus section breaker to split the 110 kV bus and upgrading bus protection in RCP2. This arrangement, combined with Vector's ability to shift load away from Roskill and manage hot water heating following a bus section outage will enable the GRS to be met until RCP3 when a third 110 kV bus section is required to more symmetrical distribution load on each bus section. The optimum bus arrangement will be confirmed as part of the detailed investigations undertaken as part of the investment approvals process.

P50 option costs	
Brief description of the approach used to estimate capex, and, if applicable, opex	A desk-top assessment of a high level scope and 'building block' cost is used to estimate the cost for each option and determine the preferred option. The cost of the preferred option has been substituted with a detailed site specific estimate. The approach and key assumptions used to compile the preferred option estimate are: • the project scope and likely location of the new assets have been determined from a desktop review of aerial photographs, site layout drawings, underground services drawings, and available cable ducts • the scope assessments have been used to estimate materials and work quantities • the component costs for material and work quantities have been taken from TEES (US cost) • material and plant costs have been determined with reference to period supply contracts currently in place and historic installation costs respectively • civil and earthworks costs have been extrapolated from historic costs; and • installation costs are informed by similar historic projects and or current quotes from service providers and applied based on the requirements of the site. The total project cost is consistent with historic costs for similar types of projects completed in the past.
Option 1 – Do Nothing	No capital cost.
Option 2	The estimated cost in RCP2 of undertaking the following works is $10.9m: • installing a 110 kV bus section breaker and upgrading bus protection at Haywards ($3.51m) • extending the existing 220 kV bus and re-arranging the 220 kV circuit connections at Bunnythorpe ($2.89m); and • installing one bus section breaker to split the 110 kV bus into two bus sections at Mt Roskill ($4.46m). Costs are +/- 30 per cent.

Net benefits and outputs	
Option 1 – Do Nothing	Costs arising from the expected incidence of non-supply.
Option 2	Preliminary approaches have been determined for the three buses. Depending on the site and the solution, some benefits of the projects are that they: • reduce interruption costs to end customers, resolving transmission capacity issues so that the core grid assets comply with the GRS; • reduce the requirement for post-contingent load or generation management;

	• address the post-contingency overloading issue; and • reduced safety and interruption risks during maintenance. Multiple bus sections will make it easier to schedule routine maintenance as the maintenance outage window will be longer.

Option risk assessment	
Option 1 – Do Nothing	The do-nothing option does not meet the GRS.
Option 2	The risks associated with the investments will be quantified once the specific investments are chosen at each site.

Preferred option(s)	
What is the currently preferred option / sequence of options / or short-listed options?	Option 2. • Haywards: by installing a 110 kV bus section breaker to create another bus section and upgrading bus protection; • Bunnythorpe: by re-arranging the 220 kV circuit connections at Bunnythorpe, with Haywards 1 and 2 circuits connected to the same bus section; and • Mt Roskill: by splitting the 110 kV bus into two bus sections by installing a bus section breaker and upgrading bus protection. Vector has confirmed they support upgrading the security at this bus.
Set out the reasons for choosing the preferred **option(s)**.	The investment proposal will improve the security of supply, and ensure compliance with the GRS.
List key **assumptions** used in determining the preferred option(s).	The investment proposals in this programme of work are site specific, and will be set out in BC2 documents during the next stage of the process. The generic approach to costing options, including assumptions made, is set out above. The demand and generation assumptions underlying the investment need are set out in AM09 - Annual Planning Report 2013.
List any **interdependencies** which the preferred option is reliant upon for a successful outcome.	The investment proposals in this programme of work are site specific. Interdependencies with other work programmes will be identified as part of the investigations for the specific sites. Obtaining outages of sufficient number and duration to undertake the work is likely to be critical to project delivery.

Steps to completion	
What are the next step(s) in choosing the solution	We will investigate and conduct analysis to confirm the preferred solution that meets the GRS. In accordance with our business case process (as described in section 3.6.1 of AM03 - Planning Lifecycle Strategy) the next steps will be to: • carry out detailed investigations (BC2) to confirm the preferred options for each of the locations; and • obtain internal approval to proceed with the projects (BC3).
When did / will the steps in the internal approval process occur / take place and where were / will they be documented and described	The process for preparing the investment proposals will include: • conducting BC2 investigations • carrying out consultation with affected stakeholders • submitting the preferred solutions for approval; and • completing the BC3 for project execution.
Identify the key services and assets that will need to be procured to complete the preferred option	The investment proposals are site specific. In the course of preparing the final investment proposal for approval, we will identify the key services and assets that will need to be procured to complete the preferred option. In accordance with our Procurement Policy, we will ensure that a robust and auditable purchase decision-making process is followed. We will complete a Procurement Plan to document the procurement process and for audit purposes. The plan helps us to plan for the external procurement of goods and services in a way that ensures we are making the most appropriate purchasing decision for our stakeholders and ourselves.
Identify the key delivery risks	• Projects not properly scoped can lead to cost overruns and not meeting deadlines. During the planning process, we will ensure project scope is adequately defined and can be implemented within the required timeframe and cost. • We will ensure the project is designed to its specification, the appropriate design reviews are completed and detailed factory inspections are carried out to manage risks. • In the process of procurement, it is essential that we select a supplier that is able to consistently meet quality requirements. Quality must not be compromised in favour of other factors because of the critical influence of quality on risk to safety and the network. • If applicable, we will standardise specifications and procurement of primary equipment to limit diversity and increase inter-changeability. This also allows procurement efficiencies to be attained. • Safety is paramount, the design of all equipment installed must be safe to operate and maintain without compromising performance. Vendors are selected with great care to ensure safe installation and commissioning work and full compliance with all our safety requirements and expectations. • All works required on site will be carried out in full compliance with all of our safety requirements and expectations.

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Supporting Documents and Models	
List of all relevant documents (including relevant policies and consultant reports) taken into account in estimating project costs and describing anticipated deliverability.	• Electricity Industry Participation Code, Part 12 (Transport) • AM09 - Annual Planning Report 2013, Section 9, Chapters 7-19
Provide a schedule of any models used (including descriptions of model operation and scope).	DigSilent version 14.1.3